
Sissejuhatus infotehnoloogiasse

1961-1966: Kaasaegse tehnoloogia sünd

- Programmeerimiskeeled: Cobol, Lisp (Fortran oli paar aastat varem)
- Dec, PDP ja miniarvutite teke
- IBM System 360 mainframed
- Integraalskeemide tootmise algus
- Engelbart, hiir ja aknad

1967-1973: Miniarvutid, protsessorid, võrk ja vabadus

- Protsessorifirmad
- Esimesed programmeeritavad kalkulaatorid ja mikroarvutid
- Mini-ja mikroarvutite tarkvara: Unix, CP/M ja programmeerimiskeeled
- Internet ja Ethernet

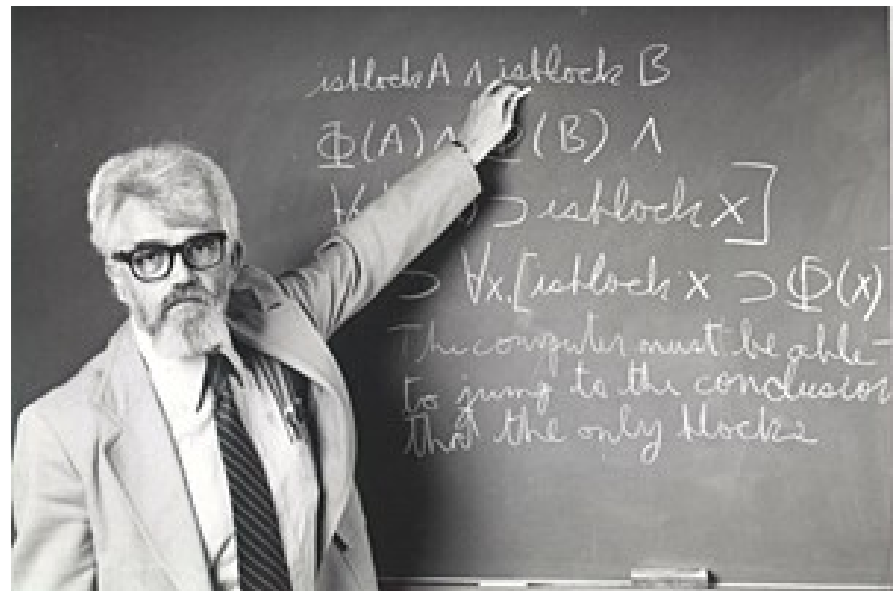
1974-1975:

- Isekokkupandavate mikroarvutite levik
- Klubivärk
- Tarkvara: C, Basic, rakendusprogrammid

1960

A team drawn from several computer manufacturers and the Pentagon developed **COBOL**, Common Business Oriented Language. Project leader: Grace Hopper.

LISP made its debut as the first computer language designed for writing artificial intelligence programs. Inventor: John McCarthy.

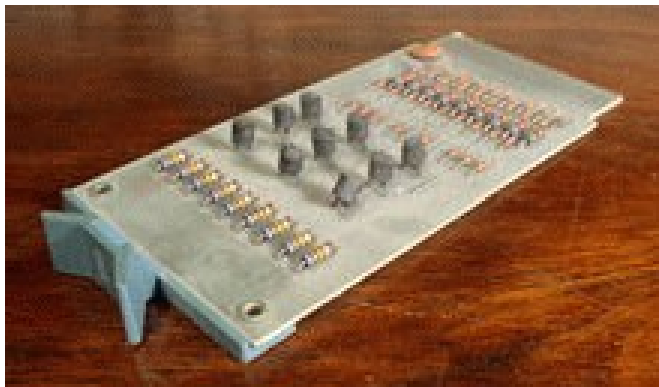


1960 DEC PDP-1: MIT TX project aftermath

The PDP-1 sold for \$120,000. MIT wrote the first video game, Space War! for it. A total of 50 were built. Each had a cathode ray tube graphic display.

No real commercial success

digital



1961

Fairchild Semiconductor releases **the first commercial integrated circuit**.

According to Datamation magazine, **IBM had an 81.2-percent share** of the computer market in 1961, the year in which it introduced the 1400 Series.

The 1401 mainframe, the first in the 1400 series, used transistors instead of vacuum tubes, and had a magnetic core memory. More than 12,000 of the 1401 computers were sold.



Teletype ships its Model 33 keyboard and punched-tape terminal, used for input and output on many early microcomputers.

Ivan Sutherland creates a graphics system called **Sketchpad**.

Douglas Engelbart receives a patent on the **mouse** pointing device for computers.

ASCII -- American Standard Code for Information Interchange
-- permitted machines from different manufacturers to exchange data

Digital Equipment **sells its first minicomputer**, to Atomic Energy of Canada.

1964 ...

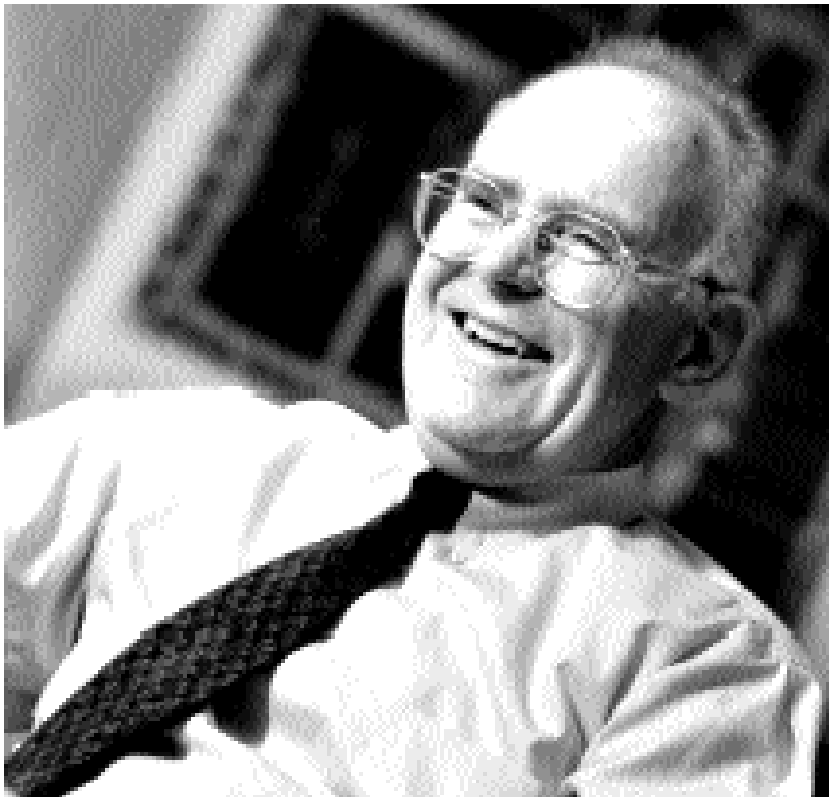
Ian Sharp and others found I.P. **Sharp Associates**, in Canada.

IBM announced **System/360**, a family of six mutually compatible computers and 40 peripherals that could work together.



...1964

Gordon Moore suggests that integrated circuits would double in complexity every year. This later becomes known as **Moore's Law**.



Gordon E. Moore

1929 -

1950 B.S. in Chemistry

1954 Ph.D. from Cal Tech

1954-1957 *Shockley Semiconductor*

1957 Co-Founder of *Fairchild Semiconductors*

1965 Moore's Law

1968 Moore, Noyce and Grove left

Fairchild Semiconductors and

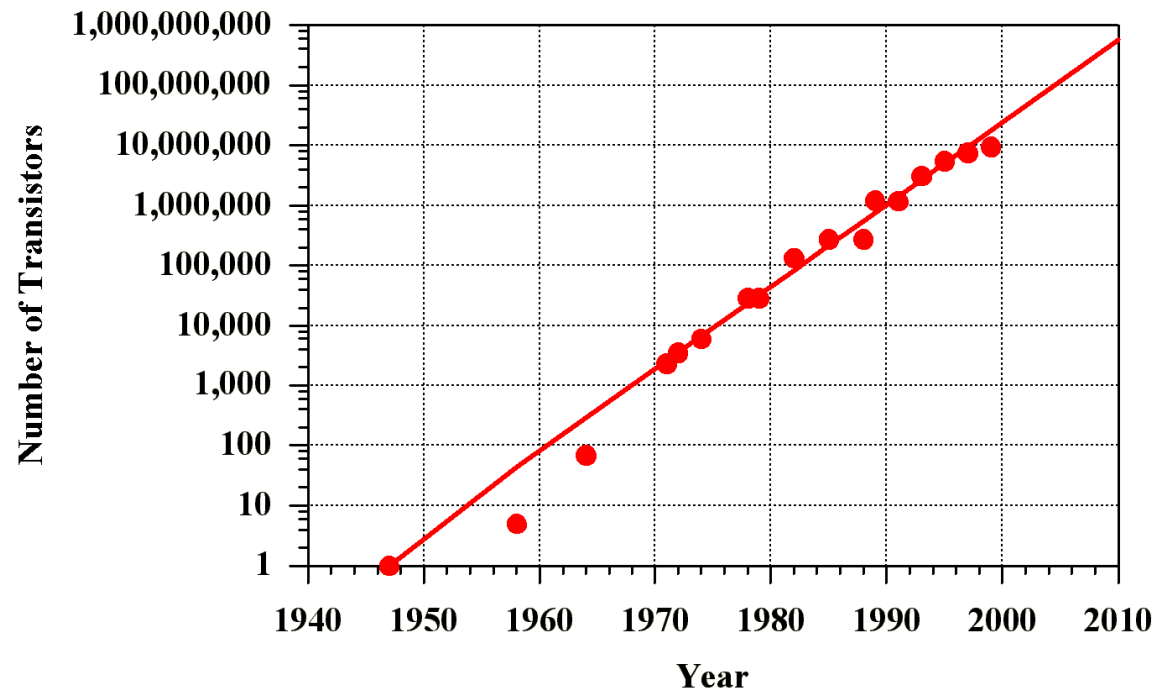
founded ***Intel Corp.***

1968-1997 Intel's president

Moore's law

Moore's Law (1965)

Circuits per chip
 $= 2^{(\text{year}-1975) / 1.5}$



“Each new chip contains roughly twice as much capacity as its predecessor, and is released within 18-24 months of the previous chip.”

CDC's 6600 supercomputer, designed by **Seymour Cray**, performed up to 3 million instructions per second -- a processing speed three times faster than that of its closest competitor, the IBM Stretch.

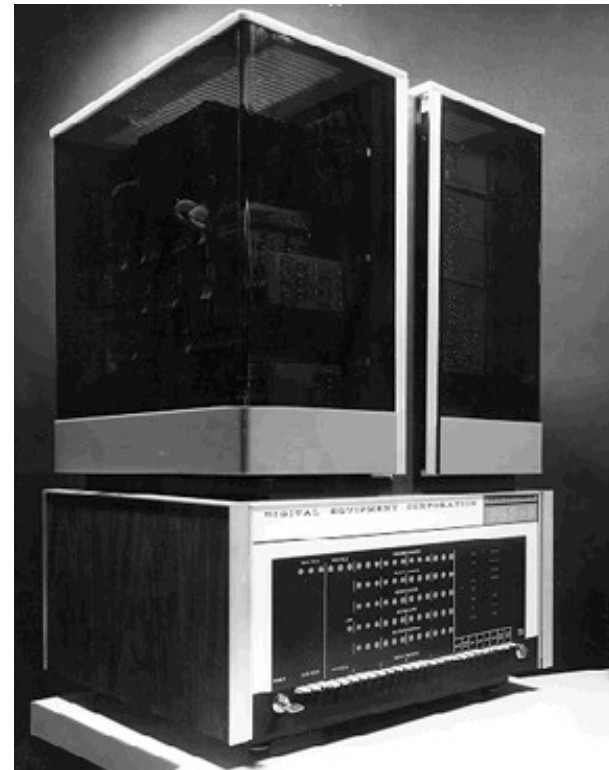
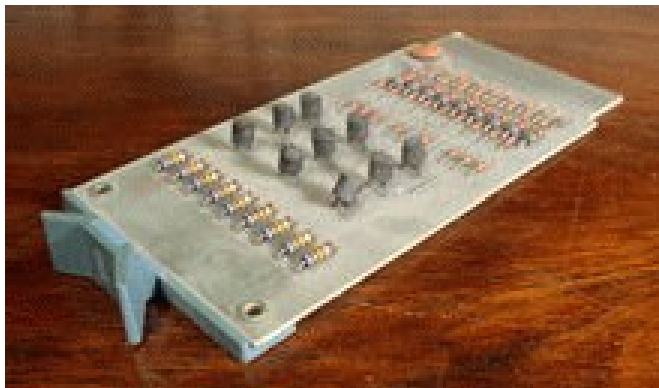
John Kemeny and Thomas Kurtz develop the **BASIC** programming language at Dartmouth College. BASIC is an acronym for Beginners All-purpose Symbolic Instruction Code.

Texas Instruments receives a **patent on the integrated circuit**.

1965

- Digital Equipment Corp (abbreviated DEC) introduced the **PDP-8**, the first commercially **successful minicomputer**. The PDP-8 sold for \$18,000, one-fifth the price of a small IBM 360 mainframe. The speed, small size, and reasonable cost enabled the PDP-8 to go into thousands of manufacturing plants, small businesses, and scientific laboratories.

digital



1966

- Steven Gray founds the **Amateur Computer Society**, and begins publishing the ACS Newsletter. Some consider this to be the birth-date of personal computing.
- **International Research Corp.** is incorporated by Wayne Pickett as a one man, California corporation. Purpose, to research educational resources and technological improvements for education

1967...

- The first Consumer Electronics Show is held in New York City.
- International Research applies for a patent for a method of constructing double sided magnetic tape utilizing a MU-Metal Foil Inter layer. Legal problems with a professor at the University of North Carolina, cause Wayne Pickette to drop the quest for that patent. Wayne Pickette makes acquaintance with the famous entrepreneur Arthur Rock of San Francisco.
- IBM builds the **first floppy disk**.

...1967

- Seymour Papert designed **LOGO** as a computer language for children.



1968...

- **Edsger Dijkstra's "GO TO considered harmful"** letter, published in Communications of the ACM, fired the first salvo in the **structured programming** wars.
- International Research Corp., in San Martin, California, develops the architecture for a computer-on-a-chip modeled on an enhanced PDP-8/S concept.
- Wayne Pickette proposes to Fairchild Semiconductor that they develop his design for a computer-on-a-chip. Fairchild turns down his offer.
- Wayne Pickette works for IBM during the Summer as a Logic Designer on Project Winchester, the enclosed flying-head disk drive. Wayne Pickette subsequently declines the IBM offer to finance his education.

- Robert Noyce and Gordon Moore leave Fairchild Semiconductors.
- Robert Noyce and Gordon Moore found **Intel Corporation**.
- Ed Roberts and Forest Mims found Micro Instrumentation Telemetry Systems (**MITS**).
- IBM scientist John Cocke and others complete a prototype scientific computer called the ACS. It incorporates some **RISC concepts**, but the project is later canceled due to the instruction set not being compatible with that of IBM's System/360 computers.

...1968

- **Douglas C. Engelbart**, of the Stanford Research Institute, demonstrates his **system of keyboard, keypad, mouse, and windows** at the Joint Computer Conference in San Francisco's Civic Center. He demonstrates use of **a word processor, a hypertext system, and remote collaborative work with colleagues**.



- AT&T Bell Laboratories programmers Kenneth Thompson and Dennis Ritchie developed the **UNIX** operating system on a spare DEC minicomputer.
- **Advanced Micro Devices** Incorporated is founded. [141]
- Intel's Marcian (Ted) Hoff designs an integrated circuit chip that could receive instructions, and perform simple functions on data. The design becomes the **4004 microprocessor**.
- Intel announces a **1 KB RAM chip**, which has a significantly larger capacity than any previously produced memory chip.
- **Bill Gates and Paul Allen**, calling themselves the "Lakeside Programming Group" sign an agreement with Computer Center Corporation to report bugs in PDP-10 software, in exchange for computer time.

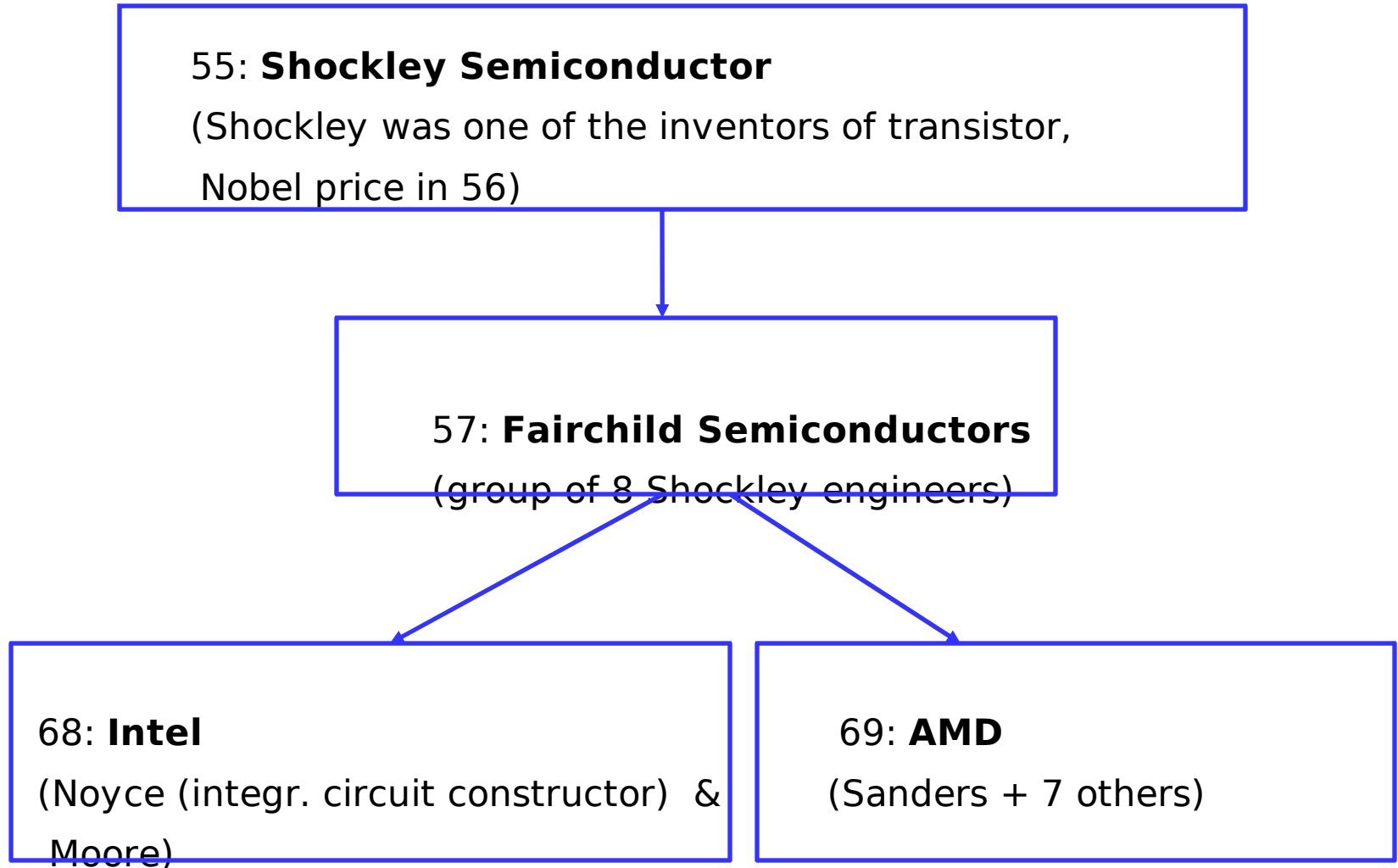
1969

- **Microsystems International** is incorporated **to manufacture microchips**. The company was formerly the Advanced Devices Centre of Northern Electric and Manufacturing Company (Canada).
- Jerry Sanders and seven others leave Fairchild Semiconductor to form **Advanced Micro Devices**.
- Gary Starkweather, at Xerox's research facility in Webster, New York, demonstrates using a laser beam with the xerography process to create **a laser printer**.
- Digital Equipment hires David Ahl as a marketing consultant.

State of the art: software and hardware

- **In 1967 MacHACK VI became the first program to beat a human (rate 1510) at a competition,** at the Massachussets State Championship.
- **In 1968 International Master David Levy made a \$3,000 bet that no chess computer would beat him in 10 years. He won his bet.** The original bet was with John McCarthy, a distinguished researcher in Artificial Intelligence
- Processors at 1968 were solded together **from a large number of single transistors and a number of small chips containing relatively small amounts of transistors each**

Recollect: Birth of Intel and AMD



- AT&T Bell Laboratories programmers Kenneth Thompson and Dennis Ritchie developed the **UNIX** operating system on a spare DEC minicomputer.
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- **Xerox** opens the Palo Alto Research Center (**PARC**).
- Intel creates the 1103 chip, **the first generally available DRAM memory chip**.
- **Wayne Pickett** takes his **computer-on-a-chip design to Intel**, and is hired, began working for Dr. Ted Hoff.
- At Intel, Wayne Pickett proposes to Ted Hoff the idea of building a computer-on-a-chip for the Busicom project.
- **Gilbert Hyatt** files a patent application entitled "Single Chip Integrated Circuit Computer Architecture", **the first basic patent on the microprocessor**.
- Work begins at Intel on the layout of the circuit for what would be the 4004 microprocessor. Federico Faggin directs the work.
- **Intel creates the first 4004 microprocessor**.

First microprocessor: Intel 4004

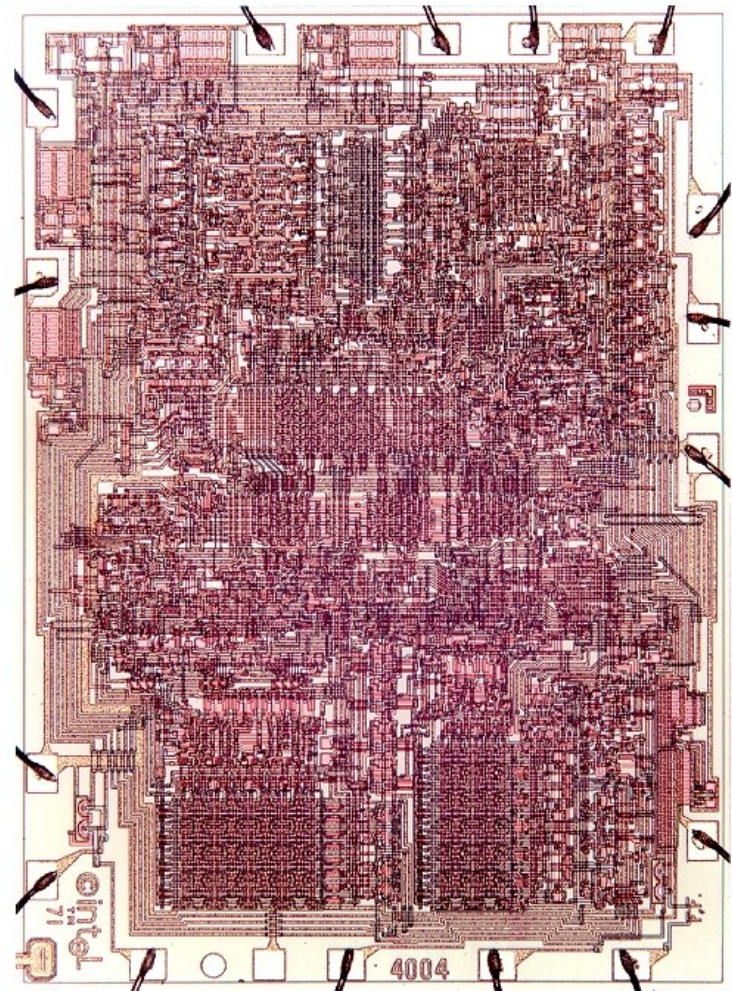
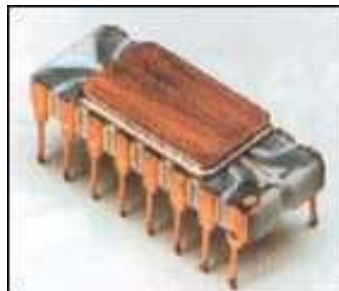
1969

The first microprocessor – CPU

1971

The first commercial 4-bit microprocessor 4004:

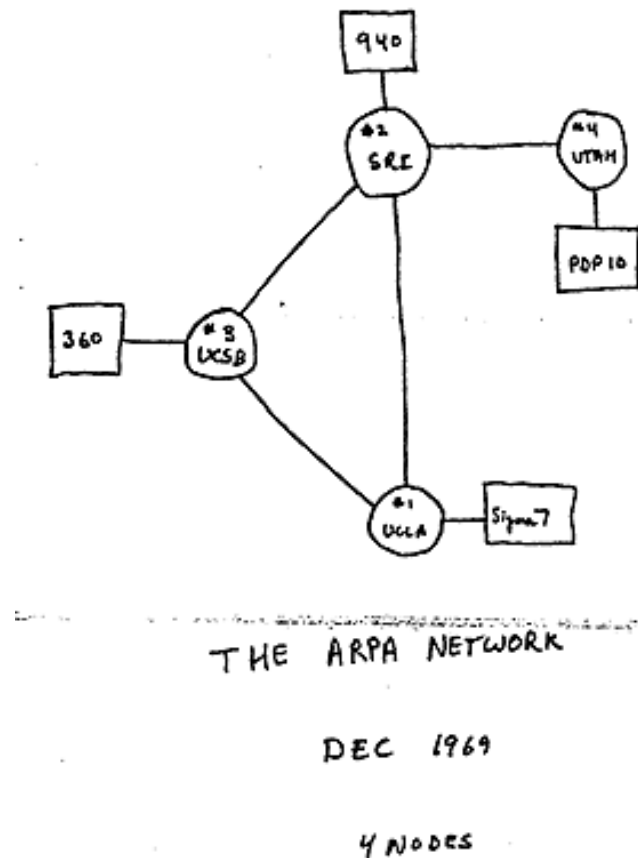
- 2,300 transistors
- 10 μm features
- 10 mm^2 die
- 108 kHz **kHz**



- **Relational database software: theory and first research groups**
- In 1970 an **IBM researcher named Ted Codd** published the first article on relational databases.
- Codd envisaged a system where the user would be able to access information with English like commands, and where information would be stored in tables.
- Due to the technical nature of the article, and the reliance on mathematics to support its case, the significance of it was not realized immediately. However, it did lead to IBM starting a **research group known as 'System R'**.
- Eventually **System R evolved into SQL/DS** which later became DB2. The language created by the System R group, **SQL** (Structured Query Language) has become the industry standard for relational databases and is now an **ISO standard**.
- **First commercial SQL database** created by **Honeywell Information Systems Inc.**, which released a commercial product in June of **1976**.

1971...

- Computer-to-computer Communication expanded when the Department of Defense established four nodes on the **ARPANET**: the University of California-Santa Barbara and UCLA, SRI International, and the University of Utah.



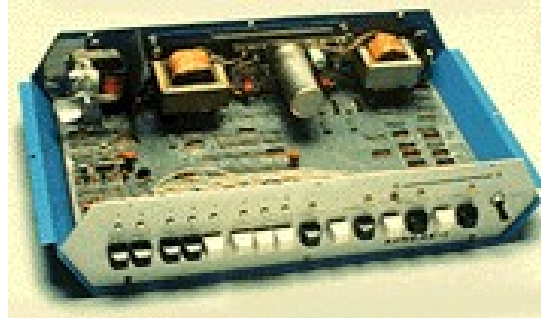
- Intel ships copies of the 4004 microprocessor to Busicom. [556.10]
- Gary Boone, of Texas Instruments, files a patent application relating to a single-chip computer.
- The newly developed device, the **EPROM**, is integrated with the 4004 to Enhance Development Cycles of microprocessor product.
- Intel introduces its **4-bit bus, 108-KHz 4004 chip - the first microprocessor**. Initial price is US\$200. Speed is 60,000 operations per second. It uses 2300 transistors, based on 10-micron technology. It can address 640 bytes. Documentation manuals were written by Adam Osborne. The die for the chip measures 3x4 mm. The chip is introduced to the public in Las Vegas by Wayne Pickette.

...1971...

- Intel announces **the first microcomputer, the MCS-4 system**. It uses the 4004 microprocessor, 4001 ROM chip, 4002 RAM chip, and 4003 shift register chip.
- Electronic News publishes **an ad from Intel promoting the 4004 chip**.
- The National Radio Institute introduces **the first computer kit**, for US\$503.
- **Steve Wozniak** and Bill Fernandez build a computer with lights and switches, from parts rejected by local companies. They call it the **Cream Soda Computer**.

...1971

- The Kenback Corporation introduces the **Kenback-1** computer, for US\$750. It uses a 1KB MOS memory made by Intel.



- Niklaus Wirth invents the **Pascal** programming language.
- Texas Instruments develops **the first microcomputer-on-a-chip**, containing over 15,000 transistors.
- IBM introduces the "memory disk", or "**floppy disk**", an 8-inch floppy plastic disk coated with iron oxide.
- **Wang Laboratories** introduces the Wang 1200 word processor system.
- Intel introduces the 1101 chip, a 256-bit programmable memory, and the 1701 chip, a 256-byte erasable read-only memory (EROM).

- Intel introduces its 200-KHz **8008 chip, the first 8-bit microprocessor**. It accesses 16KB of memory. The processor was originally developed for Computer Terminal Corporation (later called Datapoint). It uses 3500 transistors, based on 10-micron technology. Speed is 60,000 instructions per second.
- Researchers at PARC begin work on a **prototype Alto** personal computer.
- At Xerox PARC, Alan Kay proposes they build a portable personal computer, called the **Dynabook**, the size of an ordinary notebook. PARC management does not support it.
- Texas Instruments introduces the **TMS1000 one-chip microcomputer**. It integrates 1KB ROM and 32 bytes of RAM with a simple 4-bit processor.
- National Semiconductor introduces the **IMP-16 microprocessor**.
- **Steve Wozniak** develops “**blue box**” to make **free phone calls** and sells the boxes to fellow students at UC Berkeley

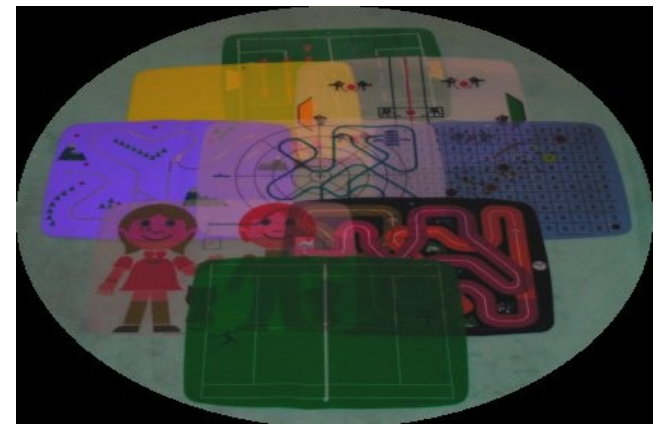
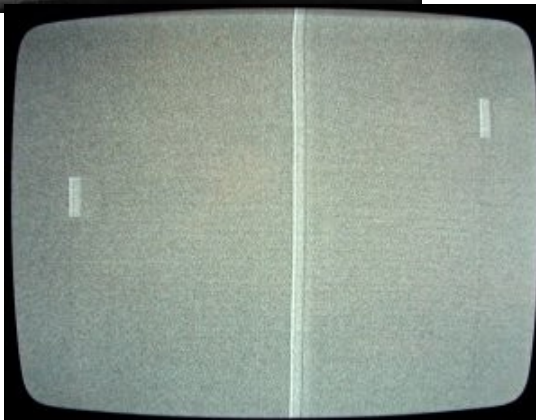
■ Some gaming stuff:

- **Space war** was a first graphical computer game, created on PDP-1 in 1961.
- In 1970, an engineer called Ralph Baer created the game called *Computer Space* based on *Space War*.
- Nolan Bushnell tried to make an arcade version of *Space War* and created *Computer Space*. *Nutting Associates* bought the game, hired Nolan and manufactured 1,500 *Space War* machines. The game was not a success because people found it difficult to play.
- **As Nolan felt he didn't receive enough pay, he created his own company: Atari in 1972.**
- **Atari ships Pong**, one of the first really successful commercial video games.
- **In 1977 Atari enters the home computer market among others**

■ Magnavox Odyssey: first home video game along



- No processor: combined analog/digital
- Plastic overlays on TV screen to get a background picture
- over 80,000 Odyssey and over 20,000 rifle packs sold in 1972
- Altogether, ca 350,000 made



1972: Colossal Cave: a text-based adventure game

- **Written by Will Crowther:** Will worked on developing the assembly language program for the original routers used in creating the ARPAnet. In their spare time the Crowthers, both avid cavers, explored and mapped portions of the Mammoth and Flint Ridge cave systems in Kentucky for the Cave Research Foundation.
- **Crowther wrote a computer simulation based on the maps, for a Digital Equipment Corporation PDP-10 computer, in FORTRAN.** His first version included caver jargon, and many of the names of rooms in this version came from actual features in the caves Will had been exploring.
- **Unfortunately, it was during this period that Crowther's marriage ended. Feeling estranged from his two daughters and wanting to be closer to them, he decided to write a program that they might enjoy.**
- **Crowther's daughters enjoyed the game, and it was passed from friend to friend during the early days of the Internet,** appearing on countless computers on and off the fledgling network.

What happened later with Colossal Cave

- **In 1976, Don Woods** was working at Stanford University's Stanford Artificial Intelligence Lab, otherwise known by the acronym SAIL. Woods found a copy of Crowther's rudimentary program left on one of the SAIL computers by some unknown Johnny Appleseed, so to speak.
- **He contacted Crowther by the simple expedient of sending email to "crowther@sitename," where sitename was every computer then on the Internet, only a mere handful of sites at the time.** After corresponding with Crowther and getting his blessings, Woods greatly expanded the program.
- Influenced by Tolkien's writing, **Woods added touches such as a troll, elves, and a volcano.**
- **Jim Gillogly** at the Rand Corporation spent several weeks in 1976 porting the code (with Woods' and Crowther's blessings) **from the original FORTRAN source into C for UNIX.** Most UNIX systems run successors of this C version. **Gillogly later ported the code to Heathkit and then IBM-PC personal computers** with the help of Walt Bilofsky, founder of The Software Toolworks (which was eventually renamed Mindscape). This version was marketed in 1981 under the name "The Original Adventure."

- Canada's Automatic Electronic Systems introduces the world's **first programmable word processor with a video screen**, the AES 90. The computer system uses magnetic disks for storage, and a custom-built microprocessor.
- **Gary Kildall** implements **PL/I** on the Intel 4004 processor.
- The People's Computer Company is founded.
- **Bill Gates and Paul Allen** form the **Traf-O-Data** company.
- Traf-O-Data develops a primitive microcomputer based on Intel's 8008 microprocessor for recording automobile traffic flow on a highway.
- **5 1/4 inch diskettes** first appear.
- Xerox decides to build a personal computer to be used for research. **Project "Alto" begins.**

- **In 1971 Ray Tomlinson** of BBN **invents email program** to send messages across a distributed network.
- In 1972 Ray Tomlinson modifies **email program for ARPANET** where it becomes a quick hit. The @ sign was chosen from the punctuation keys on Tomlinson's Model 33 Teletype for its "at" meaning
- **First computer-to-computer chat takes place at UCLA**, and is repeated during ICCC, as psychotic PARRY (at Stanford) discusses its problems with the Doctor (at BBN)

- **Two important programming concepts introduced:**
 - **The first object-oriented language Smalltalk**
developed at XEROX PARC, based on ideas by Alana Kay.
 - **The first logic programming language Prolog**
developed by Alan Colmerauer at University of Marseilles

1973...

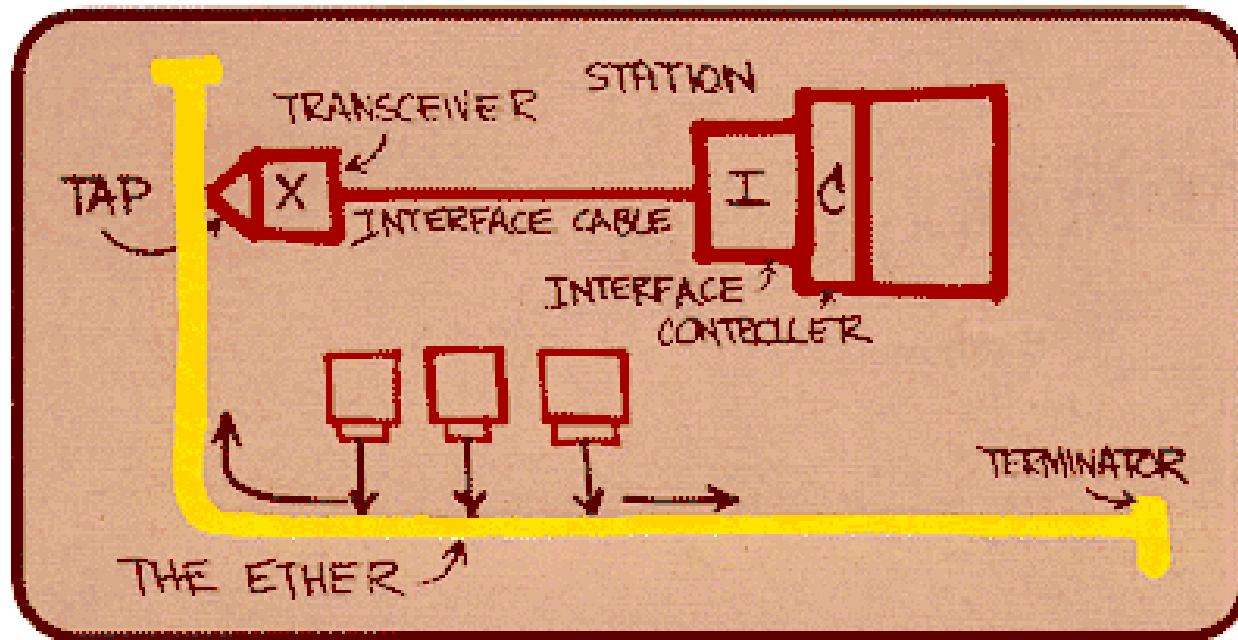
- Intel files a patent application for a "memory system for a multichip digital computer".
- The first prototype Alto workstation computer is turned on at Xerox' Palo Alto Research Center. Its first screen display is a bitmapped image of the Sesame Street character Cookie Monster.
- The first operational Alto computer is completed at Xerox PARC.
- Traf-O-Data shuts down. It made about US\$20,000.
- Design work is completed on the Micral, the first non-kit computer based on a microprocessor (the Intel 8008). Built in France, the Micral is advertised in the U.S., but is not successful there.
- The term "microcomputer" first appears in print, in reference to the Micral.

- **Hewlett-Packard introduces a programmable calculator** with a magnetic stripe memory for storing programs
- Users could write programs up to 100 lines in length and record them on blank cards, or they could buy pre-programmed cards.
- In 1975 it is used on Soyuz-Apollo mission for calculating critical course-correction maneuvers



- Gary Kildall writes a simple operating system in his PL/M language. He calls it **CP/M** (Control Program/Monitor).
- **Stephen Wozniak** joins Hewlett-Packard.
- Gary Kildall creates PL/M for the Intel 8008, based on PL/I.
- IBM develops a cheap disk and drive.
- IBM introduces the IBM 3340 hard disk unit, known as the **Winchester**, IBM's internal development code name. The recording head rides on a layer of air 18 millionths of an inch thick. It uses four 8-inch diameter platters, giving it a capacity of 70 MB.

- Gary Kildall begins consulting work at Intel.
- Scelbi Computer Consulting Company offers **the first computer kit in the U.S. using a microprocessor**, the Intel 8008-based Scelbi-8H, for US\$565, with 1KB programmable memory. An additional 15KB is available for US\$2760.
- **Bob Metcalfe** invents the **Ethernet** connectivity system.



1974...

- Intel releases its **2-MHz 8080 chip, an 8-bit microprocessor**. It can access 64KB of memory. It uses 6000 transistors, based on 6-micron technology. Speed is 0.64 MIPS.
- In a desperate act to save his failing calculator company, **MITS** company owner Ed Roberts begins building a small computer based on Intel's new 8080 chip, with plans to sell it for the unheard-of price of US\$500.
- **MITS** completes the first prototype **Altair 8800 microcomputer**.
- Bravo is developed for the Xerox Alto computer. It is **the first WYSIWYG program for a personal computer**.

Altair

- Altair was one of the first **successfully sold personal computer kits** for do-it-yourself computing fans. No monitor, no keyboard



- Keyboard and cassette drive can be added

- Oscilloscope can be attached to be used as a display



- Railway Express loses Ed Robert's only prototype Altair computer, en route to New York for review and photography for publishing by Popular Electronics.
- Les Solomon, publisher of Popular Electronics, receives Altair number 0001.
- Lauren Solomon, 12 year old daughter of Les Solomon, publisher of Popular Electronics, suggests the name "**Altair**" for Ed Robert's new microcomputer. Altair was the name of where Star Trek's Enterprise was going that night on TV.
- **Popular Electronics publishes an article by MITS announcing the Altair 8800 computer for US\$439 in kit form.** It uses the Intel 8080 processor. The Altair pictured on the cover of the magazine is actually a mock-up, as an actual computer was not available.
- Paul Allen sees the Popular Electronics issue with the Altair, and tells Bill Gates that the microcomputer revolution is just beginning.

- Gary Kildall, of Microcomputer Applications Associates, develops the **CP/M operating system for Intel 8080-based systems**.
- **Motorola** introduces its **6800 chip**, an early 8-bit microprocessor used in microcomputers and industrial and automotive control devices. The 6800 was designed by Chuck Peddle and Charlie Melear.
- Brian Kernighan and Dennis Ritchie develop the **C programming language**.
- RCA releases the 1802 processor, running at a blazing 6.4 MHz. It is considered **one of the first RISC chips**. It is used on a variety of devices, from video games to NASA space probes.
- Engineer David Ahl suggests Digital Equipment produce an inexpensive version of its PDP-8 minicomputer, for US\$5000. Top management call the idea foolish.
- Gary Kildall and John Torode begin selling the CP/M disk operating system for microcomputers.

...1974: Alto

- Xerox releases the
- Alto computer.



- A personal computer to be used for research
- Cost: \$32,000
- Never produced for profit
- **First serious machine to feature a modern user interface:** windows, mouse, etc invented by Engelbart in 1964
- Great influence on Macintosh
- Great influence on Microsoft

- Paul Allen meets with Ed Roberts to demonstrate the newly written BASIC interpreter for the Altair. Despite never having touched an Altair before, the BASIC works flawlessly.
- **Bill Gates and Paul Allen license their newly written BASIC to MITS**, their first customer. This is the first computer language program written for a personal computer.
- The **Xerox PARC**-developed Gypsy word-processing system is first field-tested by end-users. **Gypsy is one of the first word processors termed "WYSIWYG"**, meaning what you see is what you get. Gypsy runs on the PARC-developed Alto personal computer.

- Fred Moore and Gordon French hold the first meeting of a **new microcomputer hobbyist's club** in French's garage, in Menlo Park, California. 32 people meet, including Bob Albrect, Steve Dompier, Lee Felsenstein, Bob Marsh, Tom Pittman, Marty Spergel, Alan Baum, and **Steven Wozniak**. Bob Albrect shows off an Altair, and Steve Dompier reports on MITS, and how they had 4000 orders for the Altair.
- Stephen Dorsey, founder of Automatic Electronic Systems, sells his 25% of the company for \$135,000.
- The second meeting of Fred Moore/Gordon French's computer hobbyists group is held at the Stanford AI lab. 40 attend. The name for the group is chosen: Bay Area Amateur Computer Users Group - **Homebrew Computer Club**.

- Bill Gates and Paul Allen found **Micro-Soft** (the hyphen is later dropped).
- MITS delivers the first generally-available **Altair 8800, sold for US\$375** with 1KB memory.
- MOS Technology announces the MC6501 at US\$20 and the **MC6502 at US\$25**. At this point, the Intel 8080 costs about US\$150.
- Bob Marsh delivers the first Processor Technology 4KB memory boards for the Altair.
- At Xerox, John Ellenby proposes they build the **Alto II**, a modified Alto, making it easier to produce, more reliable, and more easily maintained. His request is approved.
- Bill Gates and Paul Allen sign **a licensing agreement with MITS**, for their implementation of the BASIC language.
- Bill Gates and Paul Allen ship 4K and 8K version of **BASIC v2.0**.
- Dick Heiser opens Arrow Head Computer Company, subtitled "The Computer Store", in Los Angeles, selling assembled Altairs, boards, peripherals, and magazines. **This is the first retail computer store in the USA.**

- Micom Data Systems ships its first product, the Micom 2000 word processing computer.
- (summer) IMSAI announces the **IMSAI 8080** microcomputer.
- IBM's Entry Level Systems unit unveils "**Project Mercury**", the IBM 5100 Portable Computer. It is a briefcase-size minicomputer with BASIC, 16KB RAM, tape storage, and built-in 5-inch screen. Price: US\$9000. Weight: 55 pounds. (Price over US\$10,000)
- The first issue of **Byte** magazine is published.
- MITS releases a version of **MicroSoft BASIC 2.0** for its Altair 8800, in 4K and 8K editions.
- Paul Terrell opens the Byte Shop, in Mountain View, California, one of the first computer stores in the US.
- Bill Gates writes **an open letter** to microcomputer hobbyists, complaining about software piracy, to be published in an Altair newsletter.
- Lee Felsenstein and Bob Marsh **begin work on a complete computer**, 8080-based with a keyboard and color video display capabilities built-in.

1975

- To date, MITS has sold **2,000 Altair 8800** systems.
- Wavemate releases the Jupiter II computer kit.
- Southwest Technical Products releases the M6800 computer kit.
- Canadian microchip maker Microsystems International shuts down, after accumulating losses of over \$50 million.
- IBM's John Cocke begins work on project "801", to develop a scaleable chip design that could be used in small computers as well as large.
- **Zilog** is founded.
- MITS begins work on a Motorola 6800-based Altair.
- MITS sales of Altair computers hits **US\$1 million**.
- Sphere Corporation introduces its Sphere I computer kit, featuring a Motorola 6800 CPU, 4KB RAM, ROM monitor, keyboard, and video interface, for US\$650.
- Cromemco is founded, by Harry Garland and Roger Melen. The company is named after the Crowthers Memorial dorm at Stanford.